

(NASA-CR-197132) SUPERNOVA
REMNANTS IN SUPERBUBBLES AND
HIGH-VELOCITY GAS IN PLANETARY
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Final Report for the ADP Program NRA 90-OSSA-19

Title: Supernova Remnants in Superbubbles

and

Title: High-Velocity Gas in Planetary Nebulae

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Grant Period: 9/1/91 - 8/31/92

Grant Number: NAG 5-1755

Institution: The Board of Trustees of the University of Illinois
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1 General Description

Two projects were supported by the grant NAG 5-1755: "Supernova Remnants in Superbubbles" and "High-Velocity Gas in Planetary Nebulae." Both projects used archival IUE data to study interstellar/nebular absorption properties. With this grant, we purchased a SUN Sparc IPC workstation, a 1 GByte hard disk, a SUN Sparc printer, and a license to use the software package IDL. IUE data analysis software was installed in this system and ran smoothly. The two projects are individually described below.

2 Supernova Remnants in Superbubbles

We proposed to use IUE archival data to test if interstellar absorption lines might provide diagnostics for supernova remnants (SNRs) hidden in superbubbles. The Large Magellanic Cloud (LMC) was selected in this study because of its small interstellar obscuration and confusion along the line of sight. We have examined all high-dispersion spectra of LMC stars in the IUE archives, correlated the interstellar absorption properties with the interstellar environments. We found that a large velocity difference between high-ionization lines (C IV and Si IV) and low-ionization lines (S II, Si II, and C II*) may be indicative of the existence of SNR shocks. We have also find interesting results about the hot gaseous halo and supergiant shells of the Large Magellanic Cloud. The results from this study have been reported in meeting proceedings and the *Astronomical Journal* (in the November 1994 issue). We have also obtained new IUE observations to confirm our findings. The new observations are being analyzed.

3 High-Velocity Gas in Planetary Nebulae

We proposed to use IUE archival, high-dispersion spectra of nuclei of planetary nebulae to search for high-velocity components as an indication of jets or rapid outflows of stellar material. We have plotted and examined the C IV and Si IV line profiles from every available high-dispersion, short-wavelength spectrum. The spectra are usually noisy. Only A78 and IC2149 showed obvious high-velocity absorption. We did not obtain any publishable results from the data available during the grant period. However, IUE archival data have been re-processed with NEWSIPS since then, and the quality of the re-processed spectra is improved significantly. We will repeat this project in the near future using the IUE Final Archive spectra.

4 Publications Resulted from the Grant Support

- "The Multiple-Shell Structure of the Planetary Nebulae NGC 6751." 1991, *Astrophysical Journal*, 376, 150-160.
(Chu, Y.-H., Manchado, A., Jacoby, G.H., and Kwitter, K.)
- "Ring Nebulae around Massive Stars," 1991, in *Wolf-Rayet Stars and Interrelations with Other Massive Stars in Galaxies*, I.A.U. Symposium No. 143, ed. K.A. van der Hucht and B. Hidayat (Dordrecht: Kluwer), pp. 349-363. [invited]
(Chu, Y.-H.)
- "Fast Shells and X-Ray Emission in 30 Doradus: SNRs and Superbubbles," 1991, in *The Magellanic Clouds*, I.A.U. Symposium No. 148, ed. R. Haynes and D. Milne (Dordrecht: Kluwer), pp. 97-98.
(Chu, Y.-H., and Kennicutt, R.C., Jr.)
- "X-Rays from Superbubbles in the Large Magellanic Cloud," 1991, in *The Magellanic Clouds*, I.A.U. Symposium No. 148, ed. R. Haynes and D. Milne (Dordrecht: Kluwer), pp. 99-100.
(Chu, Y.-H., and Mac Low, M.-M.)
- "Nebulae, Wolf-Rayet" 1991, in *The Astronomy and Astrophysics Encyclopedia*, ed. S.P. Maran (New York: Van Nostrand Reinhold), pp. 481-483. [invited]
(Chu, Y.-H.)
- "30 Dor B: A Supernova Remnant in a Star Formation Region," 1992, *Astronomical Journal*, 103, 1545-1551.
(Chu, Y.-H., Kennicutt, R.C. Jr., Schommer, R.A., and Laff. J.)
- "A New Survey of Nebulae around Galactic Wolf-Rayet Stars in the Northern Sky," 1993, *Astrophysical Journal Supplement Series*, 85, 137-143.
(Miller, G.J. and Chu, Y.-H.)
- "New Surveys of Nebulae around Wolf-Rayet Stars," 1993, in *ASP Conf. Series No. 35, Massive Stars: Their Lives in the Interstellar Medium*, ed. J. P. Cassinelli and E. B. Churchwell, pp. 360-362.
(Chu, Y.-H., Garcia-Segura, G., Dopita, M.A., Bell, J.F., Lozinskaya, T.A., Marston, A.P., and Miller, G.J.)
- "Highly Ionized Gas in the Large Magellanic Cloud", 1993, in *ASP Conf. Series No. 35, Massive Stars: Their Lives in the Interstellar Medium*, ed. J. P. Cassinelli and E. B. Churchwell, pp. 363-365.
(Chu, Y.-H., Wakker, B., and Garcia-Segura, G.)
- "Ultraviolet Interstellar Absorption Lines in the LMC: Searching for Hidden SNRs," 1994, *Astronomical Journal*, November issue.
(Chu, Y.-H., Mac Low, M.-M., Garcia-Segura, G., and Wakker. B.)

Supernova remnants in superbubbles and high-velocity gas in planetary nebulae

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This final report covers two projects supported by ^{this grant} ~~NAG 5-1755~~, 'Supernova Remnants in Superbubbles' and 'High-Velocity Gas in Planetary Nebulae'. Both projects used archival IUE data to study interstellar/nebular absorption properties. For the first project, IUE data was used to test if interstellar absorption lines might provide diagnostics for supernova remnants (SNRs) hidden in superbubbles. The Large Magellanic Cloud (LMC) was selected because of its small interstellar obscuration and confusion along the line of sight. All high-dispersion spectra of LMC stars in the IUE archives were examined and the interstellar absorption properties were correlated with the interstellar environments. It was found that a large velocity difference between high-ionization lines (C IV and Si IV) and low-ionization lines (S II, Si II, and C II) may be indicative of the existence of SNR shocks. Interesting results concerning the hot gaseous halo and supergiant shells of the LMC were also found. In the second project, IUE archival, high-dispersive spectra of nuclei of planetary nebulae ^{were} used to search for high-velocity components as an indication of jets

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or rapid outflows of stellar material. The C IV and Si IV line profiles from every available high-dispersion, short-wavelength spectrum were plotted and examined. The spectra found was usually noisy, with only A78 and IC2149 showing obvious high-velocity absorption. Although, no data results were published from this project, the data was re-processed with NEWSIPS and the quality has significantly improved. A list of publications resulting from this grant is attached.

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